Space Weather Technical Forecast

Issued on Sunday 2 March 2025 at 00:17 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/G2 late Tuesday 04 March and into UTC midweek. Active 24-hour electron fluence becoming Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 and 18 has been Low, with a generally decreasing cadence of C-class flares that was then capped by a peak flare of C9.6 at 01/2301UTC from the southeastern limb. This was possibly tied to a returning region in the vicinity, generating a CME off the Sun-Earth line.

There are now up to nine regions on the solar disc, with two new minor unnumbered regions becoming visible near the eastern limb, and with a third unnumbered region developing in the northeast. The current disc is mostly the preserve of relatively simple regions magnetically, however the three main groups were also the most-changed. In the northwest, AR4006 showed areal decay and consolidation to finish the period as a Cai/Beta. In the southwest, AR4007 saw its leaders fade, but this trend was countered by emergence and development of new trailers to reform the group's centre of gravity further east on the disc as a Dai/Beta. Finally, AR4009 showed a spreading and consolidating tendency, but with areal growth to reach Dsi/Beta complexity.

The leading spot group of AR4006 produced a number of jet-like emissions angled north of the Sun-Earth line in the period - these are not anticipated to affect Earth. More significantly, a large filament eruption occurred from the southeastern quadrant around S25E030 at 01/1730UTC. A Coronal Mass Ejection (CME) was then visible in Lasco C2 and STEREO COR2 imagery. This has been analysed, and a provisional result suggests a 1AU crossing time of around 04/2100UTC, although this result is subject to revision as more imagery becomes available.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, are indicative of an ongoing connection to a strong positive coronal hole fast wind (CH19/+), although this is now waning.

Solar wind speeds have been at Strong levels, gradually waning from highs near 750km/s to end the 24 hours nearer 600. The solar wind density was within average single figures ppcc. The IMF showed a declining trend, falling from 8nT to nearer 5 as the period went on, while the north-south component was erratic between +/-6nT. The phi angle was positive (away from the Sun) throughout.

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The net result of the above solar wind measures was for provisionally Quiet to Active geomagnetic indices, peaking with a Kp '4-' in the 03-06UTC interval.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background levels.

High energy electron flux was at Normal Background to Moderate levels, with a peak of 618pfu at 1745UTC. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), but on a rising trend, recording 1.89e7 integrated pfu at 01/2359UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity carries a daily Chance of becoming Moderate, with isolated M-class flares. This may rise slightly into the start of the new UTC week as regions return over the eastern limb.

Solar Wind / Geomagnetic Activity: A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow around 04/2100UTC. This forecast is subject to revision as more data becomes available.

Otherwise, fast wind influence from CH19/+ is expected to now wane, with Strong winds gradually and erratically easing to Background.

Geomagnetic activity will be mostly Unsettled on Day 1 (Sunday 02 March), becoming mainly Quiet to Unsettled for a time into the new UTC working week (from Monday 03 March). On Tuesday 04 March there is then a Chance of G1 to end this UTC day and on into midweek UTC from the aforementioned CME.

Energetic Particles / Solar Radiation: High energy proton flux is likely to be at Background levels.

High energy electron flux is likely to increase during this period. The associated 24-hour fluence also has the potential to rise, Likely breaching the Active (1e8 integrated pfu) threshold through Day 2 (Monday 03 March). The 01/1730UTC CME reduces confidence by midweek UTC, with a Chance of Active fluence surviving.

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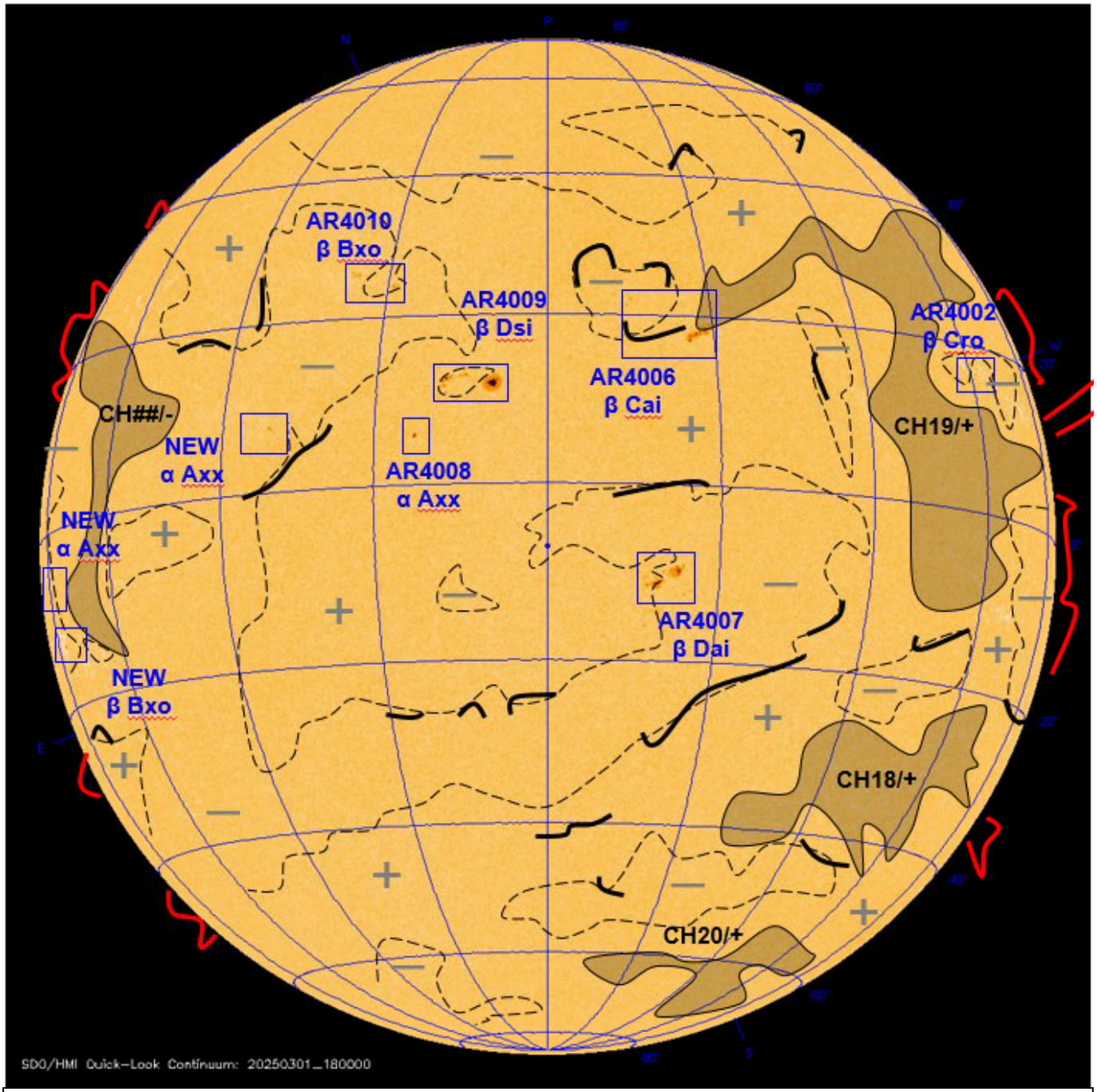
Figure 1: MOSWOC solar synoptic map, valid 01/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow around 04/2100UTC to bring a Chance of G1 to end this UTC day and on into midweek UTC. There is a Slight Chance this may reach G2 given the nature of the eruption, although it appears mainly off the Sun-Earth line. This estimate is under revision and some adjustments may arise in future guidance.

In addition to the above the otherwise ongoing fast wind influence from CH19/+ is expected to now wane, with Strong winds gradually and erratically easing to Background. No further coronal holes are expected to feature in the forecast period.

Geomagnetic activity will be mostly Unsettled on Day 1 (Sunday 02 March), becoming mainly Quiet to Unsettled into the new UTC working week (from Monday 03 March).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	20	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
02/0154UTC	Partial?	Filament eruption	SE quadrant	497	Late UTC day Tuesday 04 March, around 04/2100UTC.	Undergoing further assessment, detail subject to change. Glancing blow.

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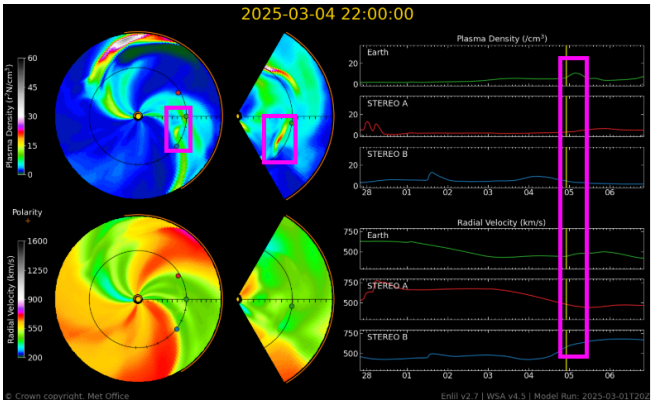
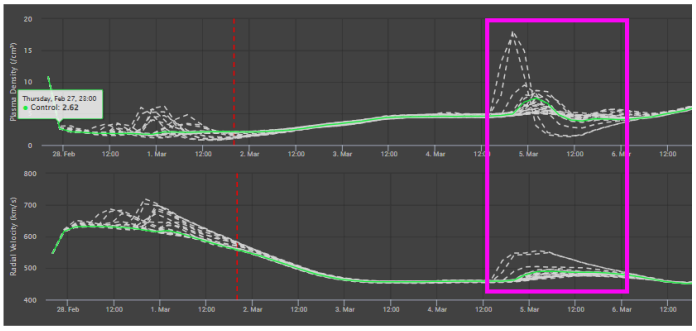
Figure 2: Latest MOSWOC Enlil model (badge time 01/2000UTC) showing the 01/1730UTC filament eruption CME as a glance around 04/2100UTC. This result is subject to revision as further imagery and analyses become available.





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Radio Blackouts - X-Ray Flares

The complexity of the current Earth-facing disc is currently relatively low, and although there are currently up to nine sunspot regions, these are for the most part simple dipoles or else Zurich Axx groups. The main regions to watch are perhaps AR4006 in the northwest given its habit of launching jet-like emissions north of the Sun-Earth line, although none has yet resulted in any obviously Earth-directed component. The other main active region on the facing side is perhaps AR4009 in the northeast, which saw some areal growth in the past 24 hours.

In terms of the evolution of the forecast, no significant regions leave the disc in the period, while there are up to three returning Carrington regions due over the eastern limb into the new UTC week. One of these was responsible for the peak flare of the past 24 hours and may be the dominant consideration into the new week.

Overall, there is a slightly rising Chance of M-class flares in the period, near the raw value for the disc as it stands.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	40	50	50	50
Very Active	R3-R5 (X Class)	No	1	1	1	1

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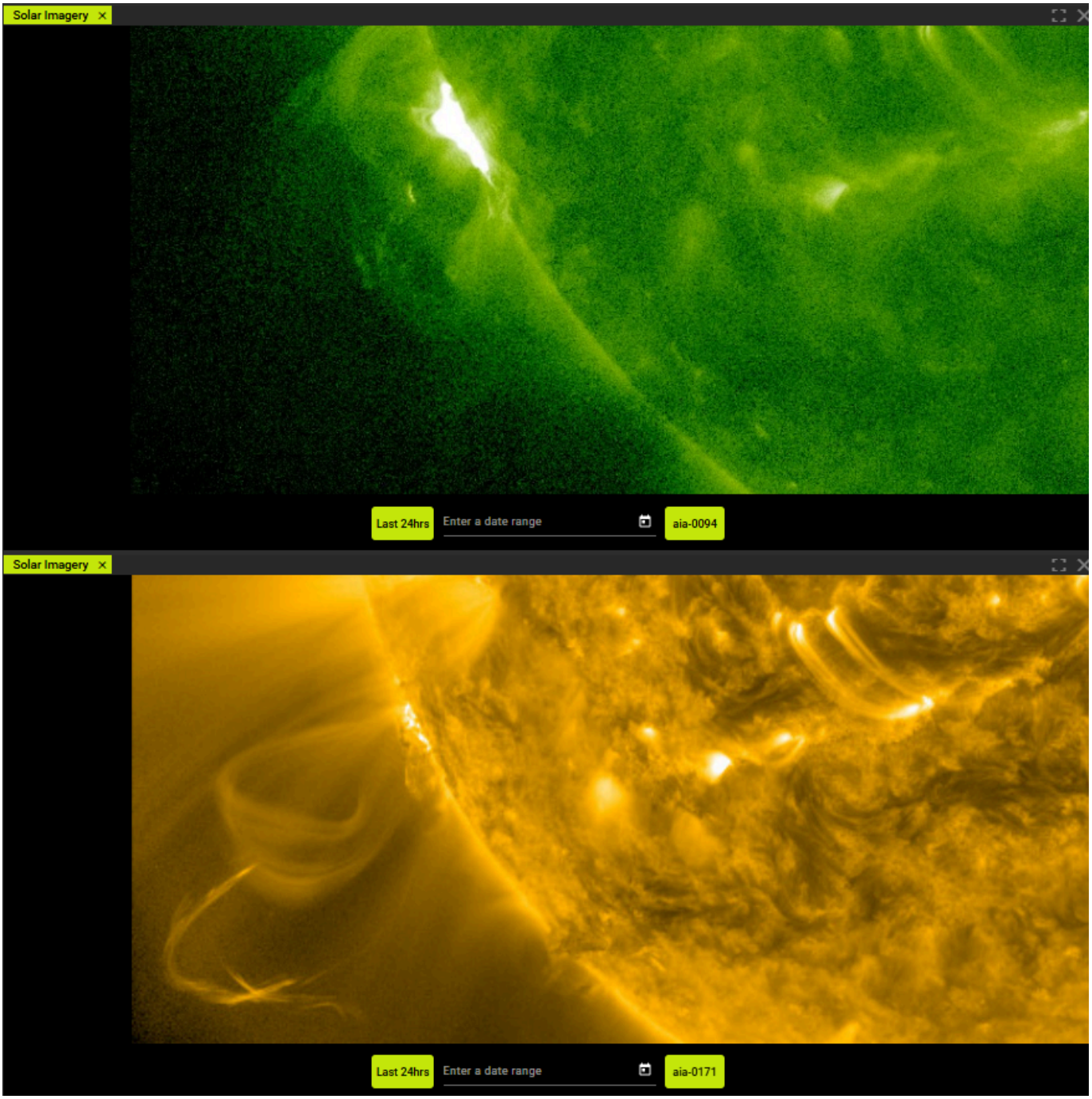
Figure 3: View of the peak flare of the 24 hours in AIA094 and 171, with an associated CME visible in the latter. Any region resonsible will soon become visible to round out the current UTC weekend, and is part of the rationale for the slightly increasing chance of M-class flares.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is at Background, and expected to remain at this level. There is a slight chance of enhancement given any significant eruption from the sunspot regions currently on the Earth-facing disc, very gradually increasing towards midweek UTC.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES16, has risen from Background to give a period of Moderate flux. This was due to the recent charging of the outer Van Allen Belt from the fast wind enhancement from CH18/+. Subsequently, this rising trend is expected to continue through until Tuesday 04 March, as the Strong solar winds and the peak electron flux through the Belt expands outwards towards GEO. Previously suggested persistent High flux becomes less certain into midweek UTC as a result of possible influence of the 01/1730UTC filament CME which may cause electron redistribution and falls of flux at GEO.

The associated 24-hour fluence should see a rising trend, Likely rising above the Active level by the end of day 2 or day 3 (Monday 03 into Tuesday 04 March). This rising trend is supported by MOSWOC REFM, although this potentially too quick with the likely enhancement, and overestimating the likely value. The evolution into day four, Wednesday 05 March is now lower confidence, being both beyond the MOSWOC REFM's range and polluted by potential CME influence, but carries a Chance of persisting should the CME be delayed or miss.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	20	60	70	40
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	5	10	5

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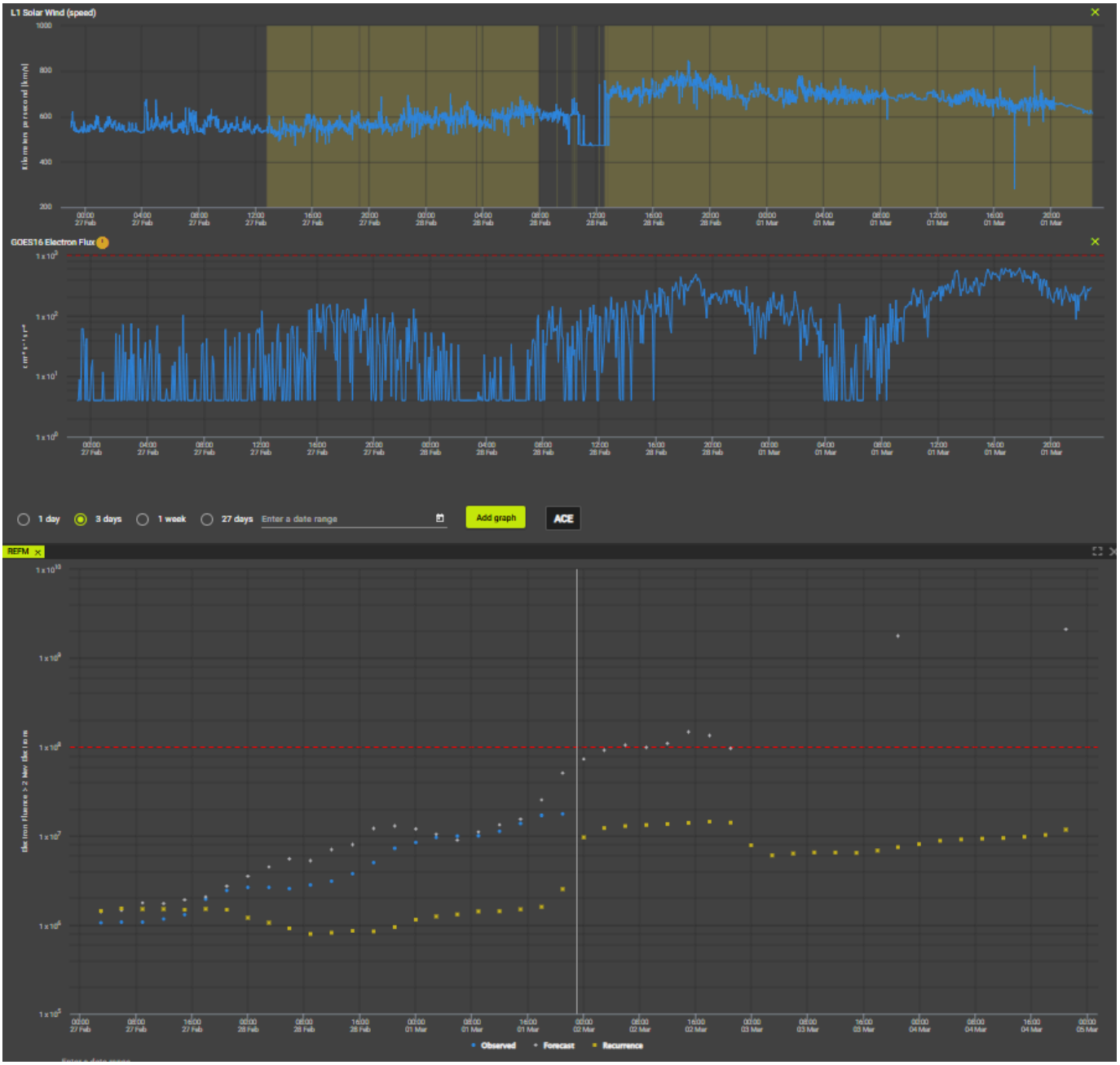
Figure 4: Past 72 hours in L1 solar wind speed (ACE in yellow shading, else DSCOVR); GOES16 high energy electron flux and 24-hour rolling fluence value (blue dots, bottom plot). MOSWOC REFM's forecast in grey dots shows a strong rise in the coming 72 hours, with the trend accepted, if not perhaps as bullishly as shown. There is considered a Slight Chance of Very Active 24-hour fluence being realised.



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